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O.B. 1432

**NOTES ON THE TACTICAL
EMPLOYMENT OF MACHINE
GUNS AND LEWIS GUNS.**

Issued by the General Staff at G.H.Q., March, 1916.



LONDON :

PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE,
By HARRISON AND SONS, 45-47, ST. MARTIN'S LANE, W.C.,
PRINTERS IN ORDINARY TO HIS MAJESTY.

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NOTES ON THE TACTICAL EMPLOYMENT OF MACHINE GUNS AND LEWIS GUNS.

INTRODUCTION.

1. The experience of the present war has shown that the general principles as regards the employment of machine guns laid down in Infantry Training 158-163 are perfectly sound, and remain unaltered by the introduction of the machine gun company organization.

The notes issued in June, 1915 (C.D.S. 36), were compiled as a result of the experience of the early stages of the war to show how machine guns had been used during the period of open fighting and with what results.

In view of the increase in the numbers of machine guns with infantry units, it is most important that all commanders should understand thoroughly the main principles of their use. These are, therefore, briefly recapitulated in this pamphlet, with the addition of certain notes on the further experience gained in trench warfare, on indirect fire, and on the special characteristics of the Lewis gun.

A comprehensive Machine Gun Manual is in course of preparation in England.

GENERAL PRINCIPLES.

2. *Characteristics of Machine Guns.*—Their chief characteristics are—

- (a) Their fire power, which is their only method of employment.
- (b) The nature of such fire.
- (c) The small target they offer and the ease with which they can be concealed.

(a) *Method of Employment.*—Machine guns, acting solely by fire, can prepare an attack or repulse an offensive, but cannot actually gain ground. This role always rests with the infantry, the only arm which is capable of moving across all obstacles.

It can, therefore, be said that, whenever action by fire alone is sufficient, it will be advantageous to use machine guns rather than

infantry, reserving the latter for the combined operations of movement and fire.

The use of machine guns, therefore, economises infantry and consequently allows a considerably larger portion to be retained as a reserve.

Owing to the small number of its personnel, a machine gun team cannot arrange for its own local protection. If sent on a detached mission, or acting on an extreme flank, a machine gun officer should apply to the nearest unit for an escort of a few rifles.

The machine gun, to a great extent, is a weapon of opportunity, and these opportunities will be very rare if a purely passive attitude is adopted. Machine gunners must be trained to use their guns very boldly, and, to enable them to do so, they must be thoroughly instructed in the use of ground, concealment and selection of positions.

It is not intended to advocate the running of useless risks, nor should any precaution as to concealment be neglected.

(b) *Fire*.—Machine gun fire produces a dense, deep, but narrow cone of fire. By increasing the traverse, the cone becomes wider, but, owing to loss of density, the effect is reduced.

Machine gun fire will therefore have its maximum power against objectives which are narrow-fronted but deep. As infantry fights normally in thin lines, the above-named conditions can only be brought about by enfilade fire. Machine guns should endeavour to fire in a direction parallel to the probable front of the enemy, i.e., from a flank.

As a general rule, frontal fire will only be directed against points which the enemy is obliged to pass, such as bridges, roads, defiles, approaches, communication trenches, &c.; that is to say, at points where the enemy is obliged to adopt a deep and narrow formation, or else when he is massed.

Only in exceptional circumstances should machine guns open fire at long ranges; normally they will withhold their fire in order to obtain surprise effect. At ranges up to 800 yards well directed machine gun fire is annihilating in its effect. A very high standard of fire discipline and fire control is necessary to obtain good effect at longer ranges.

Although the principle that machine guns should not open fire unless a good target presents itself still holds good, this must not be carried to extremes, or opportunities of inflicting both moral and material damage to the enemy may be lost. The tactical situation will guide the machine gun officer in his decision to open fire.

For instance, in a rearguard action he would engage a target which, in a defensive position, strongly held, would not justify his disclosing his position by opening fire.

Again, small parties of the enemy dribbling across open spaces to concentrate for an attack, or an extended line of infantry, may be fired on if their manoeuvre is considered sufficiently threatening, although they present a bad target for machine gun fire.

It must be remembered that it is often impossible to see anything of the enemy; therefore positions which are likely to be occupied by him should be looked for and, if necessary, searched by the fire of well-concealed guns.

It is, of course, not only justifiable, but essential, that fire should be opened to assist the advance of our own infantry.

(c) *Concealment*.—On account of the small number of their personnel, machine gun sections can take advantage of very slight cover, and are consequently able to escape detection. Machine guns—much more so than infantry—possess the power of surprise, and can thus obtain greater effects.

Opening fire by surprise will be the rule, and machine guns must therefore avoid disclosing their positions by opening fire without good reason.

Flanking fire and surprise are the two conditions which must be sought for and obtained whenever possible.

(a) *During movement* :—

When on the move, machine gunners should try to disguise their identity as such by adopting the formation of the neighbouring troops. This, and any other means of escaping detection, should be constantly practised.

(b) *When in position* :—

- (i) As few men as possible should be near the gun. It will usually be found that two men are quite sufficient.
- (ii) When time, implements, &c., are available, guns should be dug in, but, unless it is possible to construct a really satisfactory emplacement, it is better to seek cover from view. A hastily made emplacement will merely serve to draw the attention of the enemy.
- (iii) Masks and gloves will often facilitate concealment, especially when facing strong sunlight.

Every effort must be made to prevent machine guns being located by artillery. If, however, machine guns are shelled, their action will largely depend on the tactical situation. They may make a change in position of about 50 yards or they may temporarily cease fire, the guns and teams getting under cover; the latter will often deceive the enemy into thinking that they have been knocked out and enable them to get a good target later. A careful distribution of the gun numbers will minimise casualties.

When machine guns are moving, they should watch and avoid areas that are being swept by shell fire.

Machine guns which have been able to approach unseen to within close range of hostile artillery have caused them serious damage, because the gun shields have been penetrated by the bullets. Normally enfilade fire gives the best results against artillery. There are many instances of its successful employment, even at distant ranges.

3. *Co-operation.*—Co-operation is an essential feature in machine gun tactics, both between the machine guns and other arms and between the guns themselves.

Grouping machine guns into companies, by centralizing control, facilitates the execution of a comprehensive scheme of machine gun co-operation in accordance with the needs of the tactical situation. The machine gun company commander must be thoroughly conversant with the situation. He should take every step to ensure co-operation, not only between the guns of his company, but between his company and machine guns on the flanks.

EMPLOYMENT OF MACHINE GUNS IN OPEN FIGHTING.

4. It must be borne in mind that trench warfare is only a phase of operations, and to arrive at a definite decision the enemy's forces must be driven from their trenches and crushed in the open. It is, therefore, of the utmost importance that men should be thoroughly trained in the handling of machine guns in the open.

5. *With advanced guard.*—The duties of an advanced guard make it necessary that great fire power should be available when required. A large proportion of machine guns should therefore be allotted to advanced guards.

These machine guns should move well forward in the column, so that they may be able to get quickly into action.

The principal duties of machine guns with the advanced guard are to :—

- (a) Assist in driving back enemy forces by rapid production of great fire power at any required point ;
- (b) Assist in holding any position gained until the arrival of the infantry ;
- (c) Cover the deployment of the main body by holding the enemy on a wide front.

Lewis guns should be employed with the van-guard, the machine guns being with the main guard.

6. *In the attack.*—In order to obtain the best results from the machine guns, the machine gun company commander must be thoroughly acquainted with the plan of operations and must make a careful reconnaissance of the ground.

By use of maps and study of the ground through a telescope from positions in rear or on the flanks, he should endeavour to make himself familiar with the nature of the ground, the correct use of which may prove of decisive value.

Having made his reconnaissance, and having received instructions from the brigade commander, the brigade machine gun company commander will give definite orders to his section officers.

During the action he will keep in closest touch with the brigade commander.

In a battle of manœuvre, it will usually be found impossible to rely on telephones, and communication will usually be maintained by :—

Visual signalling.

Orderlies.

7. *Distribution of guns in the attack.*—The machine gun company commander may divide the guns under his command into groups :—

- (a) *Some to go forward with attacking infantry.*—i. The number of these will be governed by two factors, viz., the length of front and the nature of the ground.
- ii. The time of their advance will be determined by the nature of the ground and progress of the infantry.

These guns will be placed under the infantry battalion commanders concerned. (See I.T. 160 (13).)

It will usually be found inadvisable to move forward machine guns with the first line of infantry, and therefore the progress of the infantry must be carefully watched so as to bring forward the guns at the earliest possible moment.

In exceptional cases, when the ground is favourable, these guns may be able to push forward with the scouts and, by sudden bursts of fire, to assist the advance of the infantry.

- iii. The role of these guns will be to :—

- (a) Assist the infantry in obtaining superiority of fire.
- (b) Make good the positions won.
- (c) Pursue the enemy with fire.
- (d) Cover re-organization of the infantry.
- (e) Repel counter-attack.
- (f) Cover retirement in the event of the attack proving unsuccessful.

- iv. During the action, the section commander will keep in close touch with the commander of the unit to which he is attached.

- (b) *Some to cover the advance of the infantry.*—These guns will provide covering fire for the infantry up to the last possible moment in the following ways :—

- (a) By fire from the flanks.
- (b) By overhead fire.
- (c) By long range searching fire.

Great care must be exercised in (b) and (c) in order to avoid endangering our own troops.

Orders to the machine guns detailed for this task should always include general instructions to govern their action, after the task has been completed, pending receipt of further orders from the machine gun company commander.

(c) *Some may be kept as a reserve in the hands of the brigade commander.*—Owing to their characteristics, machine guns are most valuable as a reserve of fire power, and these guns may prove of the utmost value at the critical moment.

It must be remembered, however, that a great development of fire power is most useful in the opening stages of an attack, to cover the advance of the infantry, and it is a mistake to keep guns in reserve if they can be usefully employed in supporting the advance.

They may be used for long range searching fire on ground behind the enemy's line, which is likely to hold supports or reserves, but must be available to move forward at once, when required.

The great fire power of machine guns relative to the space they occupy, the rapidity with which they may be brought into or out of action and the ease with which they can change the direction of their fire render them especially suitable for the protection of threatened flanks and for filling gaps which may appear laterally or in depth. Any of the guns mentioned in the previous paragraph may at times be employed in this manner.

During an attack it may be advisable to continue to hold certain tactical points, which have been captured, until the attacking troops have made good their next objective. The characteristics of machine guns fit them for this duty; their use will avoid diminishing the strength and élan of the attacking infantry.

8. The machine guns that go forward with the attacking infantry will be under the control of the infantry commander to whom they are attached.

The remaining guns will be under the control of the machine gun company commander who acts under instructions from the Brigade Commander.

Machine gun officers must be acquainted with this principle in order to avoid dual control and consequent misunderstanding.

9. *Limbers and ammunition reserve.*—An officer should be in charge of the limbered wagons which carry the guns and the ammunition.

He should keep thoroughly in touch with the progress of the infantry so that he may be able to keep the wagons as close up as possible.

10. *Rear guard.*—As a rear guard will usually be required to hold positions with the minimum of men, a large proportion of machine guns should be allotted to them.

Experience has shown that well placed machine guns, supported by a few infantry only, will frequently hold up an advance for long periods.

In occupying a rear guard position with machine guns, the

ordinary principles of defence apply, but the following points should be specially noted :—

- (a) Wide field of fire.
- (b) Machine guns concealed in the least obvious places.
- (c) Covered lines of retirement must be reconnoitred.
- (d) Limbered wagons should be close up to facilitate a hasty retirement.
- (e) Positions in rear chosen before the machine guns retire from their forward positions.
- (f) A proportion of the machine guns should occupy the positions in rear, before all the machine guns retire from forward position. (Thus the retirement of the last gun can be covered.)
- (g) Pack transport is very useful.

11. *Village fighting.*—As soon as the infantry have made good one edge of a village, machine guns should be brought up in close support. They should then search windows, doorways, roofs, &c., likely to be held by the enemy.

Machine guns should be used to command cross-streets, &c., so as to guard against attack on the flanks or rear of the infantry. They should also be posted on the edges of the villages to prevent flank attacks, and when possible should be pushed forward well on the flanks, so as to command the exits from the village.

During village fighting use may be made of windows, doors, &c., as machine gun positions.

12. *Machine guns in the defence.*—When it has been decided to consolidate a position for defence a reconnaissance should be carried out. Some machine guns should be arranged as soon as possible in accordance with the nature of the ground, to form a complete belt of flanking machine gun fire along the front of the position. Also important concealed approaches and folds in the ground should be covered by machine guns.

Co-operation must be arranged with the Lewis guns of battalions, which can cover the less important approaches or small depressions or hollows which the machine guns cannot sweep.

Some machine guns should be kept in reserve. When the ground is suitable, these may be used for long range searching fire if the results are likely to justify the expenditure of ammunition, and the readiness of the guns to take up other tasks is not impaired. It will often be found advisable to prepare machine gun emplacements at important tactical points in rear of the front line and to detail guns for their occupation, if necessary. Preparation in this respect will facilitate a rapid readjustment of the line at any point.

Secondary positions and lines of retirement must be reconnoitred; steps must be taken to ensure that the teams are familiar with them. In case of a withdrawal becoming necessary, machine guns in supporting positions will cover the retirement of the

infantry and guns in the front line. When the latter have occupied their secondary positions, they, in their turn, will cover the movement of the guns originally in support.

Communication must carefully be arranged throughout machine gun sections. Machine gun officers must keep in touch with battalion commanders and the machine gun company commander.

The following points should also be noted :—

1. The position of the limbered wagon should be fixed and arrangements made for ammunition supply.
2. Range cards should be made for each gun.
3. The night and day gun positions will probably be different ; the change from the one to the other should be made just after dark and just before dawn.
4. Arrangements for firing at night should be made.

The variations that arise during the protracted defence of a position are dealt with under Trench Warfare.

13. *Occupation of various positions.*—Machine guns may be hidden in almost any position, but it is advisable to avoid places which are either obvious or easy to recognise, such as cross-roads or single objects. It is important that guns should merge into the surroundings and that straight edges or distinct shadows are not made.

Banks of rivers, canals and railways, ditches, folds in the ground, hedges, palings or walls, also mounds of earth may be used either to afford a covered line of approach and supply to a gun position or else a gun position itself. When firing over the top of the cover, greater protection is given if hollows are scooped out for the front tripod legs.

Houses may be employed in the following ways :—

The gun may be placed in rear, firing through or round the sides of the house. When firing from a window, door or hole in the roof, the gun should be placed well back for concealment. A damp piece of cloth hung in front of the gun helps to conceal the flash. When firing from a cellar, care should be taken not to fire low, as this would cause a cloud of dust to rise and give away the position. A means of retirement and alternative emplacements should be arranged. Overhead fire and observation may often be obtained from high buildings.

Woods and crops provide cover from view, facilities for communication, and good lines of approach or supply. In neither case should guns be placed too near to the front edge. In woods it will often be possible to construct hasty overhead cover.

If a barricade has been constructed across a road, machine guns should not be put on the barricade itself but, if possible, in a concealed position to a flank from which they can enfilade the road.

Haystacks do not as a rule afford a very satisfactory position, but guns may be placed in a hollow in front, or behind, firing round the side, or else in a hollow on top, firing through the front face of the stack. A machine gun concealed in a field, which is covered with cornstalks, manure heaps, or mounds of roots is very hard to locate.

Wood stacks, planks, logs of trees, and farm implements may be used to conceal guns ; cover from fire can often be obtained by the addition of bricks or sand bags.

Trees generally provide better observation posts than machine gun positions.

MACHINE GUNS IN TRENCH WARFARE.

IN THE DEFENCE.

14. *Co-operation* is essential to obtain the full value of a number of machine guns in the defence of a system of trenches. This will be facilitated by all the guns of the brigade company being placed in position by one officer, the commander of the company, in accordance with the scheme of defence arranged by the brigade commander. Co-operation between the flank guns of adjacent brigades will be arranged by consultation between the machine gun company commanders of the two brigades. Co-operation between the guns of the brigade company and the Lewis guns of battalions will be arranged by consultation between the brigade machine gun company commander and battalion commanders.

The machine guns allotted for the defence of a battalion sector are placed under the command of the battalion commander, but the arrangement of the guns should not be altered without reference to the brigade commander. All company commanders and company officers must receive clear instructions on the scheme of machine gun defence in their sector, so that guns will not be used for purposes for which they are not intended.

Machine gun commanders must be informed when a bombardment by the artillery is to take place, so that they may be prepared to take advantage of any targets presented as a result of the bombardment.

15. *Distribution of guns.*—The extra fire-power now placed in the hands of brigade and battalion commanders by the increase in the number of machine guns enables men to be economized in the front trenches, and a larger force thus left available for counter-attack.

A natural tendency is to place every available machine gun in the front-line trenches in order to establish an impassable curtain of fire in front of them. In the case of a bombardment, these trenches are liable to be very badly damaged and most of the machine guns may be destroyed. Any which have been located will certainly be put out of action. The tendency therefore to place an undue proportion of machine guns in the front line must be guarded against.

A proportion of machine guns must be placed in such a way that if, after a bombardment or by the use of asphyxiating gas, the enemy succeeds in penetrating our lines, his infantry, at every step of their advance, will be met with fire from machine guns which have been previously echeloned in depth, and will thus be compelled to stop.

It is not so necessary to cover a large area with fire, as to arrange for flanking fire from well-selected positions; this fire will sweep away the waves of hostile infantry as they try to push forward.

Commanders must therefore divide their machine guns between the front line and the ground in rear of it, and in each particular case must see that the emplacements blend with the surrounding ground and fit in with the general scheme of defence.

A proportion of the guns will be in reserve and allotted to defences in rear of the front system. They must be given a definite position and rôle in the defence scheme in case of attack. Where the ground admits, machine guns situated behind our front system of trenches may be able to render assistance by bringing fire on to hostile infantry as soon as they commence their advance. By this means the power of resistance of our front system can be supplemented by the fire of machine guns situated behind the zone of intense hostile bombardment.

Every advantage must be taken of periods in reserve to overhaul equipment and to carry on physical and mechanical training.

Guns in reserve may be used for indirect fire. Guns which form part of the defence of the front system should not be used for indirect fire (see Appendix A).

17. Machine guns in trenches may be placed—

- (a) In the sides of a salient.
- (b) " " " re-entrant.
- (c) At a bend in the trench.
- (d) In front of the trench.
- (e) In or near a support or communication trench.
- (f) In a straight line of trench firing through an oblique loophole.

Emplacements should be carefully concealed and made to harmonize with the surrounding works. A battle emplacement should be reserved for repelling an enemy attack, and should not be used for any other purpose.

Several alternative emplacements should be made, and should be marked "M.G." Emplacements must always be kept in good repair. Arrangements should be made to protect emplacements against grenade attacks.

16. *Taking over trenches.*—The machine gun company commander should reconnoitre the whole line, if possible, the day before taking over.

He should note the position of each machine gun, the area covered by its fire, all emplacements, dug-outs, ammunition depots, methods of communication, &c.

He will, subject to the brigadier's approval, issue his instructions to his section officers.

Machine gun companies should, when possible, be relieved at a different time to the infantry.

17. *Communication.*—The machine gun company commander must be in close touch with the sector commander and the section officers.

It is inadvisable to rely on the telephone system, which is usually broken during a bombardment, and all other forms of communication must be arranged, such as orderlies, visual signalling, &c.

As, however, any system is liable to break down, it is essential that all officers and gun commanders thoroughly understand the plan of action, so that they will be able to act on their own initiative.

18. During bombardments machine guns should be kept wrapped up in some waterproof cover in a dug-out. If no dug-out is available, guns should be placed in the bottom of the trench. The tripod may be left mounted in the battle emplacement.

The gun team should be distributed in order to prevent all being disabled by one shell.

Two men only are required to mount and work the gun.

19. The machine gun company commander will issue orders for the reliefs within his company; as a rule these should not be carried out on the same night as the infantry reliefs. Machine gunners will probably require assistance in changing their gun equipment, for usually it is not satisfactory to change the teams alone.

Owing to the difficulty of obtaining trained machine gunners, it has been found advisable to have only three gunners at a time with each gun in the front line. It may be necessary to give them assistance in sentry work. The remaining three men should be kept in the central depot with the reserve ammunition until they are required. These two parties should relieve each other as often as necessary.

20. *Ammunition supply.*—The supply must be carefully thought out and arranged on the following lines. With each machine gun there should be eight full belts, and 4,000 rounds in unopened boxes ready to refill the belts; the remaining full belts, the belt-filling machine, and 4,000 rounds in unopened boxes should be with the reserve gunners at a central depot battalion headquarters or some other suitable place.

The above must be considered merely as a guide. The belt boxes with the gun should be distributed between the emplacement, the dug-out, and ammunition recesses; they should be protected from shell fire and the weather.

21. An order board should be placed in each emplacement. These can be obtained from Publication Section, Stationery Services, the number being S.S/102.

The following minor points require attention.

1. Every man should know the position of guns, depots and officers.
2. To avoid detection, portions of the gun which have worn bright should be painted or covered, and periscopes should not be used in the immediate vicinity of a battle emplacement.
3. Machine guns may be fired with fair accuracy resting on the parapet, but the gunners require practice to avoid faults in feed and ejection.
4. Tap traversing is often more efficient if it is irregular; the swing traverse should not be used at distances of over 300 yards.
5. Telescopes facilitate the detection of enemy machine guns. If one which is not causing serious damage is located, it should not be knocked out until an attack is intended. Its position should be reported to the artillery.
6. If overhead fire is used the garrison of the forward trenches should be warned.
7. Very pistols are invaluable for showing up night attacks.

22. *Emplacements.*—The type of emplacement to be erected in any site must be determined by the tactical situation, and the purposes for which the emplacement is to be used.

Open machine gun emplacements should be roughly 4 feet square. If the tripod legs are dug into the parapet the dimensions may be reduced. The platform must be from 1 foot 6 inches to 2 feet below the height over which the gun is to fire, according to the splay of the legs.

For emplacements with overhead cover, the following are absolute minimum dimensions :—

5 feet long to enable No. 1 to sit or stand comfortably behind the machine gun.

4 feet wide allows only just sufficient space for No. 2 to feed the machine gun.

The minimum clearance between the bottom of the loophole and the overhead cover, which will allow the raising of the cover of the gun, to remedy stoppages during firing is, for the Maxim, 2 feet. All emplacements should be made with this amount of clearance, as although a smaller clearance is sufficient for the Vickers, it is necessary that the emplacements should be suited for either gun.

The loophole must not be less than 9 inches in height to allow the firer to take a sight on to the target. Other dimensions of the loophole depend on the degree of traverse required and the thickness of the parapet.

The most important factor that governs the construction of machine gun emplacements is the question of *concealment*. The emplacement must look like the remainder of the parapet, and must not project above it. In some places, however, they may

be made to simulate certain natural objects, such as mounds of earth or heaps of straw.

Aeroplane photographs should be studied to see if the emplacements are noticeable.

Loopholes may be made to harmonize with their surroundings, by means of carefully painted wire gauze, close mesh rabbit wire, a hinged or push-over trap door. Each of these should be set at the same angle as the rest of the parapet; the two latter should have interlaced in or attached to them grass, torn sandbag, or whatever else may lie in the vicinity. In all cases straight edges should be avoided. Loopholes can also be concealed by being blocked up with sandbags full of straw, or by being defiladed.

When the parapet consists entirely of earth it should be 6½ feet thick. If, in order to obtain a relatively large traverse without unduly increasing the size of the loophole, the emplacement is placed further forward into the parapet, the latter must be strengthened by bags full of broken brick, or by steel plates.

Head cover to be efficient should not be less than 1 foot in height.

23. *Dug-outs.*—Machine gun dug-outs should be 6 feet by 4 feet by 4 feet high. There should, if possible, be two to each gun position.

Recesses for the machine gun, spare parts, and a proportion of belt boxes, should be provided in the dug-out itself.

Ammunition recesses should be provided at the emplacement, and at other points in the vicinity, to give sufficient distribution. Those exposed to the weather may be rendered waterproof by roof felting or biscuit tins.

In the absence of a dug-out, a wooden recess for the gun may be provided in the trench, or in a shell slit.

Some notes on the construction of dug-outs and machine gun emplacements will be found in "Notes on Trench Warfare for Infantry Officers."

IN THE ATTACK.

24. The machine gun company commander must make a careful reconnaissance of the ground and study the enemy's trench system by the aid of trench maps and aeroplane photographs. Special attention must be paid to the position of enemy machine guns, known or suspected. The machine gun company commander should be able to judge the likely places for hostile machine guns to be located. He must also decide what special emplacements or works will be required for our own machine guns according to the plan of attack. These must be taken in hand as soon as the general plan has been decided.

Clear and definite orders must be issued to all machine guns as to their rôle and these should also be known to all taking part in the attack.

25. The rôle of machine guns in attack is to :—
- I. Assist the artillery, where possible.
 - II. Provide covering fire for attacking infantry, and keep down flanking fire.
 - III. Fill up gaps which may occur laterally or in depth.
 - IV. Assist in consolidation of position won and repel counter attacks.

It is most important that all machine guns are allotted a definite task and given definite orders.

The guns of the brigade company may be allotted as follows :—

- I. Some to cover the advance by firing on enemy's parapet from the flanks, an advanced position, or commanding positions in rear, and to engage enemy machine guns on flanks.

These guns should cover retirement if assault fails.

- II. Some to follow up assaulting infantry.

Lewis guns only will go forward at first with the infantry, but some of the machine guns should be ready to go forward immediately, when the hand to hand fighting is finished. These guns should not open fire before the advance, and the line of advance should be carefully selected beforehand. They may also be employed to fill gaps and consolidate tactical points in rear of assaulting troops.

- III. Some guns may be held in reserve at the commencement under the brigade commander, and may be used for firing from positions in rear, on points where enemy are likely to mass for counter attack. Guns should never, however, be kept in reserve, if they can be usefully employed in assisting the advance from the outset.

The officer in charge of guns in reserve must keep in close touch with brigade headquarters and be ready to go forward at once, when required.

During the preliminary bombardment the machine guns can render considerable assistance by preventing the repair of wire entanglements and damaged parapets, by direct or indirect fire. It may also be found possible to interfere with enemy reliefs or reinforcements, by bringing indirect fire to bear on communication trenches, and roads used by the enemy.

Depots for spare gunners, ammunition, minor repairs, and belt-filling machine should be arranged in good dug-outs. Each depot should be under a N.C.O., and the whole under an officer, who will push forward depots as required.

NOTES ON THE TACTICAL HANDLING OF LEWIS GUNS.

26. *Characteristics of machine guns and automatic rifles.*—The characteristics of a weapon determine its tactical handling, and in order to arrive at the best methods of using machine guns and automatic rifles respectively, it is necessary to compare their characteristics.

The principal characteristic of the machine gun is its ability to produce *rapid and sustained fire*. Provided water and ammunition are available, a machine gun is capable of keeping up a rapid fire for a very considerable period.

On the other hand, an automatic rifle (of which the Lewis gun is a type), though capable of extremely rapid fire, is incapable of sustaining this fire for long. This necessitates, therefore, the use of short bursts of fire as the normal practice.

Its inability to sustain fire is primarily due to the fact that a water jacket is not provided (in order to economise weight) and the gun consequently becomes hot very quickly. Further, owing to their lightness, the working parts will not stand constant vibration to the same extent as those of the machine gun.

A further difference between the two weapons is in the type of mounting supplied. To increase its mobility the Lewis gun is provided with a light tripod, whereas the machine gun has the heavier Mark IV tripod.

The fixed platform provided by the use of this latter tripod enables the machine gun to be used for overhead fire, a form of fire for which the Lewis gun is unsuitable.

27. *Methods of employment.*—The differences in characteristics outlined above suggest the best uses to which the Lewis gun can be put. *It must be clearly understood that the Lewis gun cannot take the place of the machine gun.* It is a supplement to, and not a substitute for the machine gun.

It is necessary, in considering the uses of this weapon, to regard it from two points of view, *i.e.*, in trench warfare and open fighting.

The former will be dealt with first, not because it is the most important, but because it is the form of warfare in which we are now engaged.

28. *In trench warfare.*—Lewis guns should be used in a defensive line to economise infantry and to supplement the machine guns of the brigade company, not to take their place. They can be used in co-operation with the guns of the brigade company to sweep depressions, covered approaches, &c., on which these guns cannot fire. Lewis guns fire over the parapet and can therefore often sweep ground invisible from a machine gun emplacement, which is usually sited near ground level and therefore has a low command. There must be the closest co-operation between the battalions and the

commander of the brigade machine gun company over the choice of the positions and tasks for Lewis guns.

As Lewis guns are company weapons, their number in the front line will be determined by the number of companies holding it.

Owing to the mobility of the Lewis gun, and the absence of a fixed platform, emplacements, in the ordinary acceptance of the term, are not required. The Lewis gun can be fired off its light mounting over any portion of the parapet with very little preliminary preparation and its fire can be brought to bear on an object very rapidly; a much greater liberty of action can therefore be allowed to this weapon than to the machine gun.

Although emplacements are unnecessary, definite "firing places" must be prepared, either by means of loopholes or in depressions in the parapet, defiladed from the front if possible.

In allocating Lewis guns to a portion of the defence, certain fronts should be given to them, and the teams should be thoroughly familiar with their "firing places," and the ground to be swept from each.

It is just as essential to keep Lewis guns under cover during a bombardment as it is to keep machine guns and their teams. In the case of the former weapon, however, as there are no definite emplacements, greater choice is possible in the selection of the spot for the shelters, provided the guns can come into action without delay.

The object of strong points is to bring a sudden and intense fire on the enemy from an unexpected direction if he has succeeded in breaking through the front line of defence. Machine guns are more suitable than Lewis guns for this purpose, owing to their greater capacity for sustained fire. Lewis guns can, however, be used in places affording only slight cover, and will also provide a mobile reserve of fire for use as required.

29. *In the attack.*—(a) *The attack from trenches.*—Owing to its lightness and the small target it offers, the Lewis gun is of great value in an attack. It is particularly adapted for providing covering fire from the front during the first stage of an attack. Lewis gunners, under cover of darkness, smoke, or artillery bombardment, may be able to creep out in front and establish themselves in shell holes, ditches, crops, long grass, &c., where it will be difficult for them to be detected, and where they will be able to fire on enemy machine gun emplacements, loopholes and parapets generally, and so assist the infantry to advance. Covering fire on the flanks of the attack must, however, be provided by machine guns as they can keep up a sustained fire from stationary platforms on previously considered objectives.

It is inadvisable to send forward any machine guns or Lewis guns with the first line of attacking infantry, but as soon as the infantry have got into the enemy's trenches, Lewis guns should be pushed up as rapidly as possible; they can provide the necessary fire while the infantry is re-organising and preparing the enemy's

captured trench and will be especially useful on the flanks. They will, in fact, as far as their nature allows, take the place of machine guns, till the latter arrive to consolidate the position won.

Special instructions should be given to Lewis gunners to look for enemy machine guns and concentrate their fire upon them.

Lewis guns will also be of great value in minor operations from trenches and in supporting grenade attacks.

(b) *The attack in open warfare.*—In open fighting both sides will strive to obtain superiority of fire as early as possible; the addition of mobile fire power to the infantry by the possession of Lewis guns will materially assist them in their task.

Although in trench warfare it will usually be inadvisable to send forward Lewis guns with the leading line, owing to the short distance to be traversed and to the fact that there are obstacles such as barbed wire to be passed, in open warfare, where attacks will probably be made over long distances, and where the enemy's position is only hastily entrenched, it will be possible to push forward Lewis guns with the leading line, the gunners moving and appearing to the enemy as ordinary riflemen. Lewis guns pushed forward in this way will be able to provide covering fire for the infantry and will thus help them to advance.

Where ground is suitable, it may sometimes be possible for Lewis gunners to precede the attacking infantry, and opportunities to carry this out should be carefully looked for.

An opportunity for pushing forward Lewis guns may occur when an advance is held up or a hostile counter attack develops. In this way superiority of fire may often be obtained without incurring the loss incidental to sending up strong reinforcements to the front line.

30. *Summary.*—To summarise, Lewis guns will be of great value for the following purposes:—

- (i) To supplement the fire of infantry and machine guns.
- (ii) To economise infantry in trench warfare and in defensive positions.
- (iii) Firing from the parapet to command ground which cannot be swept by machine gun fire.
- (iv) To provide covering fire from the front during an attack.
- (v) To assist in the consolidation of positions won, and to cover the re-organisation of the attacking troops.
- (vi) For small enterprises, where the weight and visibility of the machine gun would render the latter unsuitable.
- (vii) As a means of reinforcing a line of infantry with additional fire power, under circumstances where the deployment and sending forward of more men would result in heavy losses.
- (viii) To provide a mobile "reserve of fire" in the hands of company commanders.

It should never be forgotten that the Lewis gun like the machine gun is a weapon of opportunity, and that surprise is the chief element of success in its use.

APPENDIX A.

NOTES ON INDIRECT FIRE.

1. Indirect or long range searching fire can be used for the following purposes :—

Fire by day or night on support and reserve lines, communication trenches, cooking places, ration parties, and roads and areas likely to be used.

When co-operating with artillery, opportunity may occur of inflicting loss by means of indirect fire should direct fire be inadvisable. Should the artillery succeed in blowing in fire or communication trenches, machine guns may be laid and fired on the broken parts of the defences, so catching the enemy during his attempts to repair this damage. During a feint attack, indirect machine gun fire directed on to communication trenches may impede the arrival of reinforcements.

During a feint attack carried out by a division in Sept., 1915, considerable loss was inflicted by indirect machine gun fire employed in co-operation with our artillery. A feint smoke attack was initiated, and the Germans, on seeing the smoke-proceeded to send forward reinforcements up their communication trenches. The artillery opened on these communication trenches and destroyed them. Machine guns also opened on these trenches with indirect fire at the same time. Owing to these trenches being destroyed and blocked, the Germans came out into the open to advance. The machine guns, which were informed by telephone, traversed their fire and succeeded in stopping the reinforcements and inflicted considerable loss among them.

Again, when there is a likelihood of fog, darkness or smoke in a gas attack concealing the target from vision, arrangements ought to be made and necessary measures taken to resort to indirect laying, so that fire may still be brought to bear on the target, if necessary. An instance of this having been successfully done is reported by a division which was engaged in the fighting at Loos in September, 1915. The report runs—

“Though direct fire could be normally employed it was considered wise to provide against targets being concealed by the smoke cloud, during and after the gas and smoke attack; for this purpose elevations were taken by level and clinometers, and aiming posts were placed in position for day and night firing.

“This precaution proved invaluable, as direct aiming and observation were impossible for some time, owing to the smoke.”

2. Normal periods of trench warfare offer favourable conditions for the use of indirect fire, inasmuch as the positions of friendly and hostile forces are clearly marked. It is of the utmost importance, however, that officers in charge of guns firing indirectly should be

thoroughly conversant with all the factors which will decide, not only whether the effect obtained will be commensurate with the expenditure of ammunition and the wear of the gun, but also if the margin of safety is sufficiently great to avoid endangering our own troops.

3. The chief considerations which must be borne in mind are as follows :—

(a) *Number of guns.*—It must always be remembered that machine guns are the framework on which a line of defence is built, and that a sufficient number must always be present and ready. This fact will have a considerable bearing on the number of guns available for indirect fire.

After the necessary number of guns has been detailed for defensive purposes, the remainder of the guns may be utilized for indirect fire, but, as a general rule, the fewer guns that are used for this purpose, the better. Rest is essential for the teams, and wear and tear on a gun which is constantly in use becomes very noticeable. It rarely happens that continuous indirect fire is advisable and therefore one gun should be able to take on a fairly large number of targets.

Lewis guns, owing to their characteristics, are unsuitable for indirect fire and should never be used for this purpose.

(b) *Selection of targets.*—Indirect fire simply for the sake of firing is to be discouraged. No firing should take place unless there is some specific object to be attained, and the target to be fired at should be decided upon by the staff of the brigade or division. As there are many technical considerations with which no one who has not studied this problem will be familiar, it is advisable that the brigade machine gun company commanders should be consulted by the general staff as to whether the proposed targets can be effectively engaged by indirect fire of machine guns.

It may sometimes happen that the target can be enfiladed best from positions in the area of another division, in which case arrangements should be made between the staffs of the divisions concerned.

(c) *Selection of site for firing.*—The first consideration in the selection of the actual gun position is concealment. A machine gun is a very small object for an aeroplane at any height to detect, and it will usually be possible to conceal the gun from the front by placing it on the reverse slope of a hill. In areas which are more or less systematically shelled, dug-outs should be constructed for the teams and guns, into which they can retire if shelled. An emplacement is not of such importance as cover for the gun team, as there is usually no necessity to continue firing while under shell fire.

Houses, the vicinity of cross-roads and artillery observation stations should be carefully avoided, as the two former

are easily located on a map, and the latter should not be interfered with in any way that might give away their position.

- (d) *Selection of range.*—This is one of the most important considerations, and all officers superintending indirect fire must be thoroughly familiar with the method of ascertaining width of cones of fire, angles of descent, &c., and the various factors that affect the flight of the bullet, usually termed “errors of the day.”

Several examples of overhead indirect fire are given below, demonstrating the method of determining the safety or otherwise. It may be broadly stated that the further back (within limits) the guns are placed the greater the safety and the greater effect likely to be produced on the enemy.

It is also obvious that concealment is easier at a longer range, and probably the number of targets that can be engaged is larger.

The fall of the bullet at long ranges has a far greater searching effect, as will be seen from the fact that at 1,500 yards the fall is 1 in 12, and at 2,800 yards it is 1 in 2.

- (e) *Special Instructions for Officers Superintending.*—(i) A worn barrel should not be used.
 (ii) All calculations should be carefully checked.
 (iii) Troops in front should always be warned.
 (iv) Climatic conditions must be carefully studied.
 (v) Clinometers, if used, should be tested before use. The R.A. should be asked for assistance in case of difficulty in adjusting.
 (vi) The tripod legs must be dug in in order to ensure rigid mounting.
 (vii) The necessity for good holding must be impressed on the firer.
 (viii) The laying should be checked frequently both for direction and elevation.
 (ix) Whenever possible, observation, which is of the utmost value, should be arranged.
 (x) It is advisable, after laying the gun, to place a batten under the front of the barrel-casing in order to prevent the muzzle becoming sufficiently depressed to endanger our troops in front.

NOTE.—The necessary tables for making calculations for trajectories, width of cones, &c., are given on the enlarging block for indirect fire.

The examples given below are calculated for Maxim guns. The table of angles of tangent elevations for the Vickers' gun is given in Appendix D.

EXAMPLES SHOWING NECESSARY CALCULATIONS UNDER VARYING CONDITIONS. FULLY EXPLAINED.

No. 1.

G = machine gun ; O = our trenches ; T = target.

Suppose range GT = 2,400', GO = 2,100', and G, O and T all to be on same horizontal plane. After putting on the tangent elevation for the range, the next step is to consult the 100 per cent. cone trajectory tables, which show the bottom of 100 per cent. cone. At 2,100' the bottom of the 100 per cent. cone is 209 feet above the line of sight, therefore the clearance above the heads of our troops is 209 feet.

NOTE 1.—This ought to be sufficient clearance, provided the “holding” is good, and the tripod rigid, as 209 feet at 2,100 yards subtends an angle of 1° 54' at the gun. Given proper care, it ought to be possible to prevent the angle of elevation on the gun decreasing by so much as to be dangerous to our troops at O.

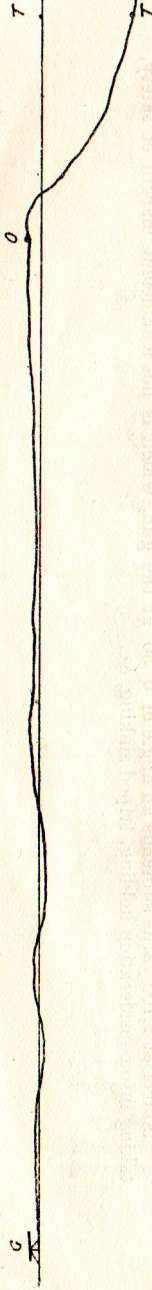
If O were much above the line GT the clearance might not be sufficient for safety ; for example :—

Suppose O to be 119 feet above GT.

The bottom of the 100 per cent. cone is 209 feet above GT at O.

Therefore the clearance would be 209 - 119 feet = 90 feet.

90 feet at 2,100 yards subtends an angle of 0° 50' at the gun, which is not a sufficient margin of safety, taking into consideration holding, tripod sinking, &c.



G = machine gun ; O = our troops ; T = target ; GT = horizontal plane on which gun stands.

Suppose range to T = $2,300^x$, suppose range to O = $2,000^x$.

Suppose O to be $20'$ above G, suppose T to be $90'$ below G.

The angle of tangent elevation for $2,300^x = 6^\circ 26'$, so, if the gun be fired when laid at an angle of $6^\circ 26'$, the centre of the cone will pass through T and miss T.

Therefore the range must be shortened until the centre of the cone hits T. The amount by which the range, or angle of elevation for the same, must be shortened is arrived at by the formula for the "angle of sight." Accordingly $60 \times \frac{-90}{2300 \times 3}$ (NOTE.—As the numerator is expressed in feet, the denominator must also be expressed in feet.)

$= -0^\circ 47'$ (NOTE.—The answer derived from the formula is shown as minus because T is below G. If T were above G it would have been shown as plus.)

Therefore angle to be put on gun is $6^\circ 26' - 0^\circ 47' = 5^\circ 39'$.

But $5^\circ 39'$ is the tangent elevation for 2,200 yards (within two minutes), and on consulting the trajectory table it will be seen that in the $2,200^x$ trajectory the bottom of the 100 per cent. cone at $2,000^x$ (O) is 105 feet. Therefore difference in height between the 100 per cent. cone and O is $105 - 20 = 85'$.

$85'$ at $2,000^x$ subtends an angle at the gun of $0^\circ 49'$. This is not a sufficient margin of safety, even though O is not closer than 300 yards from T. Accordingly, indirect fire ought not to be employed in this case at this range. If the gun be brought back till the range to the target is $2,800^x$, it will be seen to be safe.

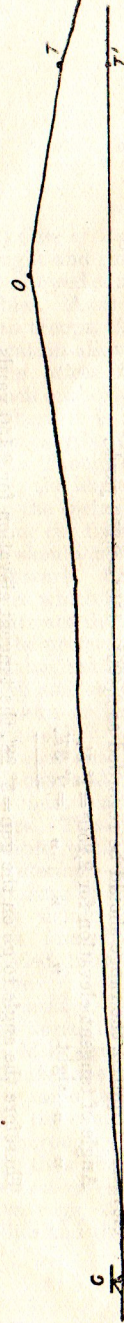
For example—Angle of tangent elevation for $2,800^x = 11^\circ 50'$.

$$\text{Angle of sight} = 60 \times \frac{-90}{2800 \times 3} = -0^\circ 31'.$$

Therefore the angle to go on this gun = $11^\circ 19'$.

This would be the tangent elevation for a range of about 2,750 (*vide* Table of Tangent Elevations), but for the sake of safety, say, 2,700 x . O from target is 300 yards. Therefore O from gun = 2,500 yards.

From the trajectory tables, at $2,500^x$ in the $2,700^x$ trajectory, the bottom of the 100 per cent. cone is 218 feet high. To find the clearance, subtract the height of O ($20'$) from $218' = 198'$. This subtends an angle at the gun of $1^\circ 31'$, which should give a sufficient margin of safety.



G = machine gun ; O = our troops ; T = target ; GT = horizontal plane on which gun stands.

Suppose range to T to be 2,200 yards.

" " " O " 1,900

" " " O to be 100 feet above GT.

" " " T " 80 " " GT.

Angle of tangent elevation for 2,200 yards = $5^\circ 41'$, so if the gun is fired with this elevation on it, the centre of the cone will pass through T and miss T.

$$\text{Angle of sight to T} = 60 \times \frac{+80}{2200 \times 3} = +0^\circ 44'.$$

(As T is higher than G, the answer to the formula is shown as plus.)

Accordingly elevation to go on gun = $5^\circ 41' + 0^\circ 44' = 6^\circ 25'$.

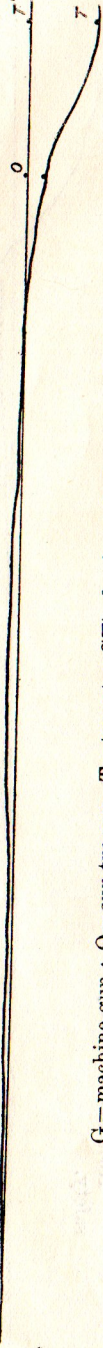
$6^\circ 25'$ is the tangent elevation for a range of 2,300.

From the trajectory tables, in the 2,300 yards range the height of the bottom of the 100 per cent. cone above GT at $1,900^x$ (O) is 233 feet.

But O is 100 feet above GT.

Therefore the difference in height between bottom of cone and O is $233 - 100$ feet = 133 feet.

Now 133 at 1,900 yards subtends an angle at the gun of $1^\circ 20'$, which ought to be a sufficient margin of safety.



G = machine gun ; O = our troops ; T = target ; GT = horizontal plane on which gun stands.

Suppose range to T = 2,400 yards.

" " O = 2,100 "

" O to be 15' below GT "

" T " 75' " GT "

We will first deal with the above problem as it is, and afterwards as it will be with two atmospheric influences.

Tangent elevation for 2,400 yards = $7^{\circ} 17'$.

Angle of sight = $60 \times \frac{-75}{2,400 \times 3} = 0^{\circ} 37'$.

Therefore angle to go on gun = $6^{\circ} 40'$.

$6^{\circ} 40'$ is the angle of tangent elevation for a range of about 2,340^x, for safety say 2,300^x.

From trajectory tables in the 2,300^x range the bottom of the 100 per cent. cone at 2,100 yards is 125' above GT. Therefore the difference in height between O, which is 15' below GT, and the bottom of the 100 per cent. cone is $125' + 15' = 140'$. 140' at 2,100^x subtends an angle at the gun of $1^{\circ} 16'$, which ought to be sufficient margin of safety.

Now consider the same case with two influences requiring a reduction in range. From the tables we see that with two influences at 2,400^x the reduction amounts to 150^x. Accordingly, as regards the angle of tangent elevation required, the range should be regarded as $2,400^x - 150^x = 2,250$ yards.

Angle of tangent elevation for 2,250^x = $1^{\circ} 5'$.

" " sight " " = $0^{\circ} 37'$.

Therefore the angle to go on the gun = $5^{\circ} 28'$, the tangent elevation for 2,150 yards.

But distance to O is 2,100 yards.

Therefore it is obvious that under these circumstances it is altogether too dangerous to employ indirect fire.

APPENDIX B.

NOTES ON TRANSPORT.

(i) *Care of Animals.—Feeding.*—The Government ration for light draught and riding horses is :—12 lbs. hay ; 10 lbs. oats ; they are also allowed some straw for bedding when standing on asphalt or cobbles. As it is not always possible to send the full ration of hay up to troops, C.Os. are usually allowed to buy enough to complete the ration allowance through the imprest account.

The prices for these purchases are fixed each month by the French authorities.

Where it is not possible to buy hay, some clean oat or wheat straw may be mixed with the hay in order to make up sufficient bulk. Though it has little feeding value, it will be beneficial in filling the horses' stomachs.

In the spring and summer green food may be bought in the same way or cut from roadsides, &c. This tends to have a laxative effect and should not be given in large quantities to horses that are in hard work. Carrots may be mixed with feeds, especially those of horses which are dainty feeders.

Oats are the best grain on which to feed horses, but other grain will be preferable to none when oats are not available.

Maize, barley, wheat and beans all tend to overheat a horse's blood, and should, if possible, be boiled before use. A proportion of maize or barley is good, however, when horses are exposed to much cold.

Horses should be fed *at least* three times a day, after watering, with oats and hay.

It must be remembered that some horses eat more slowly than others. These should be kept undisturbed by other horses, if possible, while feeding.

Watering.—Horses should be watered as often as possible. Watering is harmful only after feeding or before very fast work. They should be allowed to drink their fill unless they have to work immediately after watering. A horse has not always satisfied himself the first time that he lifts his head from the water.

Grooming.—A regular grooming three times a day will assist to keep horses in condition. When this is not possible, heels and legs should be dried and hand-rubbed to prevent cracked heels. When animals have winter coats and are unclipped, this will be particularly important in order to prevent lice.

In the summer, or when it is possible to clip them, they should be thoroughly groomed and belted with a wisp of straw in order to keep their coats and skin in a healthy condition.

Clipping.—In places where horses can be got under cover or have rugs, it is generally advisable to clip the hair from their bellies and the underside of the neck up to the gullet. These parts

take a long time to dry if a horse has been sweating in a long coat. In the open, however, it will be better to leave them undclipped.

Stabling and Standings.—Horses which are kept for long in the open should be provided with proper standings. The site of these should be sheltered from the prevailing wind, where possible. Shelters should be built out of hurdles and straw, with a roof of tarred felt, as soon as practicable.

In the summer horses will probably *do* better in the open than in stables that are stuffy or hot.

During a March.—Horses in draught should be ridden in turn and changed over, if possible, during a long march. Girth should be loosened and poles let down whenever halted for any length of time.

Horses should be watered and their eyes and noses sponged out on every occasion.

(ii) *Driving.*—The principle of driving is that each horse should do an equal amount of work. Before starting, the traces of all the horses should be taut; it is important that the leaders do not take the strain before the wheelers.

When going uphill the drivers should lean forward and give their horses their heads.

When driving downhill the traces of the lead-horses must not be taut; the wheelers should take the weight of the wagon gradually, avoiding sudden checks; the brakes should not be used more than necessary; the horses' heads should be as free as possible.

When checking the pace or halting, the lead-driver should raise his whip horizontally in line with his forehead to pass the signal back down the column; he should not check too suddenly, or he may damage the wheelers.

When wheeling, the outside horse should not be allowed to lag behind; care must be taken that the leaders do not turn so sharply that they pull the wheelers off their feet. Drivers should always carry whips, but should rarely use the lash.

(iii) *Fitting Harness.—Bit.*—The bit should be placed in the horse's mouth so that the bar of it is about 1 inch above the tush of a horse or 2 inches above the corner tooth of a mare.

The *bridoon* should lightly touch the corners of the horse's mouth, but be low enough not to wrinkle them.

Girths when tightened should admit two fingers between them and the horse's body.

The *nose-band* on the head-collar should lie two fingers below the projecting cheek-bone, and allow two fingers between it and the horse's nose.

The *throat-lash* should allow two fingers between it and the horse's jaw when the horse is "at attention."

The *neckpiece and neckstrap* should be flat and smooth in the pad just in front of the horse's withers. Great care must be taken that withers are not chafed by the pad becoming displaced.

The *wagon load* should be distributed so that little weight is brought to bear on horses' necks.

The *breast harness* should lie evenly between point of the shoulder and windpipe. If too low, it will gall the former, and if too high, it will bear on the latter and restrict the animal's breathing. A gall must therefore be protected by pads placed on either side of it, and the breeching or breast harness must not be lowered or raised. A gall should be kept clean and bathed with salt and water.

The *breeching* should lie evenly; it should be short enough so that when the animal checks the wagon the whole weight is not taking its neck. The breeching should, however, not be too short, or it will interfere with the movement of the hindquarters and gall them.

Care of Harness.—Leather should be kept pliable by means of soap, dubbing or oil. Those portions which become caked with sweat should be washed in cold water before the above are applied. Steelwork should be kept oily and free from rust.

(iv) *Pack Transport.*—Pack-animals may be used when, owing to shell-fire or some other reason, it is necessary to cross ground over which the limbered wagon cannot pass. Pack-animals are easy to conceal, and, with the help of a billhook and wire-cutters, can cross enclosed country. The pack-leads on each side of the animal should be equally balanced both laterally and longitudinally. If the lead is too high, it will swing and cause a sore back; if too low, it will impede the animal's breathing. The load for infantry pack-animals should not exceed 200 lbs.

(v) *Care of Vehicles and Leads.*—1. Grease the axle-box.

2. Grease the limber-hook.

3. In hot weather the wood of the hubs is apt to become dried, thus loosening the spokes.

(To prevent this, a rope of straw should be laced through the spokes close to the hub and always kept wet.)

4. Do not allow water to stand in the body of the wagon.

5. Paint the wagon as often as possible.

6. Load the wagon so that when the pole, without the bar supporting draught-pole, is raised to the height of the chest, it remains balanced in this position.

APPENDIX C.

NOTES ON THE PROPER METHOD OF ATTACHMENT OF CUPS, MUZZLE ATTACHMENT.

On page 12 of the Handbook of '303" Vickers Machine Gun, 1914, it states :—

"The muzzle cup is bored at the rear end to fit on to the end of the barrel. This end of the cup is split, and is arranged to receive a transverse clamping screw for fixing the cup rigidly to the barrel."

As an amendment and amplification of this is added:—

“When placing the muzzle cup on the barrel the screw must coincide with the flat on the muzzle to allow the cup to pass. After the cup has been pushed home, it must be given a half-turn to bring the clamping screw into the cannellure and away from the flat. It must then be screwed firmly up with the combination tool. Neglect of this will lead to the cup being broken or blown off.”

Owing to the considerable number of cups, muzzle attachment, which are being broken, the following points should be observed:—

- (1) See that the cannellure in the barrel is quite clean and that the muzzle is not burred.
- (2) Clean that portion of the cup which fits on to the barrel, and see that it is free from fouling, especially where the face of the muzzle seats against the internal shoulder.
- (3) When assembling the cup to the barrel be quite certain that the cup is placed on the muzzle as far as it will go before trying to turn it round.
- (4) Ensure that when the cup is home on the barrel that a complete half-turn is given to it.
- (5) Screw the clamping screw up firmly, so ensuring that the cup will not turn. *Force* should not be used.

Failure to carry out the above points will most probably cause damage to the cup, as it may turn and work forward, and so leave a space between the face of the muzzle and the internal shoulder. On firing, the powder gases emerging from the barrel will then cause great pressure to be exerted against the internal shoulder, which fatigues the metal and ruptures the cup at this point.

Note.—Paraffin is useful as a partial solvent of fouling.

APPENDIX D.

TABLE OF ANGLES OF TANGENT ELEVATION FOR VICKERS MACHINE GUN.

Range in Yards	Angle of Elevation	
	Deg.	Min.
100		3
200		7
300		11.5
400		16.5
500		22
600		28
700		35
800		43
900		52
1,000	1	2
1,100	1	13.5
1,200	1	26.5
1,300	1	41
1,400	1	57
1,500	2	15
1,600	2	35
1,700	2	57
1,800	3	21
1,900	3	47.5
2,000	4	16.5
2,100	4	48
2,200	5	22.5
2,300	6	
2,400	6	41.5
2,500	7	27
2,600	8	16.5
2,700	9	11
2,800	10	10.5
2,900	11	15

APPENDIX II

TABLE OF AVERAGE OF LARGEST ELEVATION FOR VIOLETS

Anglo of Elevation

Range in Violets

100

200

300

400

500

600

700

800

900

1,000

1,100

1,200

1,300

1,400

1,500

1,600

1,700

1,800

1,900

2,000

2,100

2,200

2,300

2,400

2,500

2,600

2,700

2,800

2,900

3,000

3,100

3,200



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